20. Fly Investigations Reports. IV.—Some Enquiry into the Question of Baits and Poisons for Flies, being a Report on the Experimental Work carried out during 1915 for the Zoological Society of London.

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These experiments testing various substances on flies, were made with the object of finding out which were the most suitable to use as baits for traps, while others were tested as possible poisons. The work was undertaken under the direction of Prof. H. Maxwell Lefroy for the Zoological Society of London, during the summer and autumn of 1915.

The experiments in connection with Blow-flies were made in the Society's Gardens, Regent's Park; those on House-flies, at Acton Lodge, Brentford; while the work on poisons was done, for the most part, at the Imperial College of Science and Technology, South Kensington.

Baits for Blow-flies.

The well-known habits of blow-flies, and their attraction to dead and decaying animal matter, suggested three main lines of enquiry for experiment on blow-fly baits:—

I. To try to find out whether any of the decomposition products or other organic compounds are attractive to blow-flies when isolated, and used as baits.

II. To see which of the meaty substances are most attractive, when, and under what conditions.

III. To experiment in a similar way with vegetable substances, to see if they are at all attractive.

The flies used in these experiments were those which were

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most common at the Zoological Gardens during the early summer, viz. :—

(a) *Calliphora erythrocephala* and „ *vomitora* ..... } The Blue-bottles.
(b) *Lucilia cæsar* ..... The Green-bottle.
(c) *Protocalliphora grœnlandica* (released from breeding-cage).
(d) *Musca domestica* ..... The House-fly (scarce)*.
(e) *Fannia canicularis* ..... The Lesser House-fly.
„ *scalaris*..... The Latrine-fly.
(f) *Piophila casei* ..... The Cheese-fly.
(g) *Sarcophaga carnaria* ..... The Flesh-fly.

I. *Methods and account of experiments with various organic compounds.*

In these experiments the usual method adopted was to soak pieces of blotting-paper in the different substances to be tested, and to place them inside or outside the wire gauze breeding-cage (in which *P. grœnlandica* were bred). At the same time, controls consisting of similar pieces of blotting-paper soaked in water were placed beside each. The results were compared, and a note made as to whether the number of flies (if any) which came to the chemicals was equal to, greater, or fewer than the number which came to the controls.

The various substances used, classified according to their attractiveness, are given below (A–E).

A. *Substances found to be attractive to* P. grœnlandica.

Honey.
Cane-Sugar molasses.
Beet „ „
Lactose (solution in water).
Maltose „ „
Glucose „ „
Fructose (solution in water).
Lævulose „ „
Cane-Sugar „ „
Urine (6 days old).
„ (16 days old).
Uric acid.

B. *Substances found to be decidedly repellent.*

Pipendine.
Œnanthol (weak).
Xylol.
Oil of Thyme.
„ Cassia.
„ Java Citronella.
„ Ceylon Citronella.
„ Palma rosa.
„ Bay.
„ Heliotrope.
„ Lavender.
Oil of Cinnamon leaf.
„ „ bark.
„ Sassafras.
„ Cloves.
Camphor.
Amyl acetate.
Methyl salicylate.
Anisole.
Citral (strong).
Ethyl sulphocyanide.

* Very few house-flies were seen in the Zoological Gardens during these experiments, probably because it was still early in the season for them; although they were never at all abundant there, even in August and September.

C. *Substances deterrent, though in a less degree than those given in* B.

Pyridine.
p-Cresol.
Naphthaline.
Phenetole.
Hydrogen sulphide water.
Quinol.
Butyric acid.
Carvone.
Quinoline.
Anethole.
Ammonia (weak).
Urine (fresh).
Borneol (in alc.).
Carbon bi-sulphide.
Aniline.
Guiacol.
Toluene.
Urethane.
Dimethylaniline.
Vanillan.
Ethyl acetate.
Allyl sulphocyanate.
Ethyl nitrite.
Amyl nitrite.
Lactic acid.
Cedar-wood oil.

D. *Substances which gave no definite results.*

Methyl Indol.
Indol.
Pyrogallol.
Paraformaldehyde.
Ammonium butyrate.
„ benzoate.
„ valerate.
α-Naphthaline.
Skatol (strong).
„ (dry).
Trimethylamine (weak).
Urea.
Tyrosine.
Guanine HCl.
Betaine.
Dimethylamine.
Methyl alcohol.
β-Naphthol.
Quinine sulphate.
β Mono-methyl-uric acid.
Trimeth. HCl.
Acetal.
Uric acid (dry) + artificial musk.
Ethereal extract of horse-manure.
NaOH „ „ „
Alcoholic „ „ „
HCl „ „ „
Precipitate by HCl from NaOH extract of horse-manure.
Precipitate by NH_4OH from HCl extract of horse-manure.

E. *Substances which gave the same results as the controls.*

Valeric acid.
Aspartic acid.
Formaldehyde.
Tannic acid.
Leucine.
Stearic acid.
Oleic acid.
Theobromine.
Terpin OH (alc.).
Potass. salicylate.
Salicylic acid.
Ethyl formate.
Phenylacetic acid.
Caffeine.
Acetone.

Nothing of much practical value was obtained from these experiments. They gave, however, indications of the likes and dislikes of the flies (*P. grœnlandica*), and so appeared useful in differentiating between the tastes of blow-flies; certain substances (A) were attractive, while others (B and C) were repellent or distasteful in varying degrees; others, again, gave no definite results (D) or the same results as the controls (E). Since these experiments were made with one species only, i. e., *P. grœnlandica*, it does not follow that the results will be true for other

species also; in fact, subsequent experiments showed that tastes varied in different species of blow-flies, *e. g.*, honey and sugar were very attractive to *grœnlandica*, but not at all to *Lucilia* and *Calliphora*, although some of the substances gave similar results with the different species. The essential oils tested were found to be repellent to *grœnlandica*, and in those cases where tests were made with *Lucilia*, *Calliphora*, and *Musca*, they were seen to be repellent to them also. They may, therefore, be found useful as ingredients in sprays or unguents.

Experiments were also made to test the effect of certain organic compounds, etc., on house-flies *.

The following methods of testing them were employed:—

(1) In which pieces of blotting-paper were soaked in them and exposed in sunny places in the greenhouse.

Substances tested.	*Results.*
Ammonium butyrate	Disliked by the house-flies.
„ benzoate	„ „ „
Amyl acetate	„ „ „
Methyl Indol	„ „ „
Trimeth. chlorhydrate	„ „ „
Vanilla	„ „ „
α-Naphthaline	„ „ „
β-Naphthol	„ „ „
Ethyl sulphocyanide	„ „ „
Beet-sugar molasses	„ „ „
Urethane	„ „ „
Guanine HCl	„ „ „
Guanadine HCl (+NaOH)	„ „ „
Trimeth. chlorhydrate (+NaOH)	„ „ „
Leucine	A few flies settled on this.
Artificial musk	Disliked by house-flies.

(2) In which the substances were added to mixtures of casein, sugar, and water, and exposed for two days on the bench in the "fly-room" at the Imperial College (December).

All were harmless to the flies, nor were any as attractive as the controls.

A summary of results is given below:—

Substances tested.	*Results.*
12·5 c.c. Casein + 12·5 c.c. Brown Sugar + 12·5 c.c. Water (Control) = A	Very attractive throughout whole experiment.
12 drops Safrol + A	Unattractive.
12 drops Santal + A	„ ; flies repelled at first.

* The account of these experiments testing certain organic compounds on house-flies is placed here, so as to be available for comparison with the similar experiments on blow-flies.

12 drops Hellibore + A	Not very attractive, non-poisonous.
12 drops Pyrethrum Extract (Alc.) + A	„ „ „
12 drops Xylol + A	Unattractive, until Xylol had evaporated, when flies came to feed.
6 drops Oil of Geraniol + A	Unattractive at first, later a few flies came.
6 drops Oil of Thyme + A	Repellent at first. Second day when smell of thyme less, a few flies came.
Bread soaked in water	Very attractive while moist.
25 c.c. Casein + 25 c.c. Brown Sugar + 25 c.c. Water (Control) = B	Very attractive.
12 drops Fusel Oil + B	Unattractive.
1 c.c. "Army Spray" + B	„ , non-poisonous.

(3) In which certain substances were tested against Bacterized Blood *. These experiments were made in the greenhouse in July. In some (*a*) a drop of the blood and another of the substance to be tested were placed on a piece of blotting-paper, side by side yet not touching, while in others (*b*) the two drops were mixed.

(*a*) Vinegar. Propionic acid. Absolute alcohol. 95 % „ Amyl „ Carvone. Pyridine. Oil of Cloves. Formic acid. Acetal.

(*b*) Xylol. Methyl salicylate. Butyric acid. Acetic „

It was noticed that, generally, the house-flies disliked coming in contact with the chemicals, although they did not appear to detect them from a distance. They fed greedily at all places where they could get at the blood without touching the chemicals. A few flies, however, came for a short time to formic acid, methyl salicylate, butyric and acetic acids.

Xylol was distinctly repellent, but after it had evaporated the flies settled on the blood.

(4) Other experiments were also made with Dried Blood, one day old, mixed with water and also with casein and sugar baits, etc. It was found to have no special attraction either for house-flies or blow-flies, apparently making no difference to an attractive bait, nor rendering an unattractive one attractive.

* This Bacterized Blood (*i. e.*, Blood prepared with putrefying Bacteria) was found by experiment to be very attractive to house-flies, and also when mixed with casein, sugar, banana, and water. Apparently it had no special attraction for blow-flies (*Lucilia* and *Calliphora*), either alone, or mixed with casein baits, with or without shredded meat.

11. *Methods and account of Experiments to find out when and under what conditions meaty substances are most attractive to blow-flies.* (*June and July.*)

All these experiments took place out of doors, the baits being exposed in sunny places in the Zoological Gardens; for it was found that even when a very attractive bait was placed in the shade, practically no blow-flies came to it, although they had been swarming round it when it was put in the sun.

The different substances were at first placed in shallow dishes, partially covered by glass plates, so that the flies could enter and feed, and the smell diffuse into the air. Later, however, it was found more convenient to use glass pickle-jars (height 9 inches, diameter 4 inches) fitted with wire-gauze funnels, which prevented the flies from escaping when once they had gone inside.

The number of flies caught in these jars was noted each morning and evening, but when dishes were used they were kept under as continuous observation as possible during the day, and the attractiveness of the bait estimated by the number of flies which had fed during that time.

The average length of time of each experiment was from six to seven days.

The first substances to be tried were meat and hard-boiled egg, of different ages. It was seen that after becoming blown their attractiveness was increased. This was especially the case when they had been kept for a few days, and were in a more or less liquid condition, owing to the digestive action of the maggots. At this stage they were very attractive to the blow-flies, the meat more than the egg, though numbers of flies came to both.

This effect of maggots on substances was further tested in later experiments, when two similar pieces of meat were put out side by side. To the one, maggots were added, while the other was kept covered with wire gauze to prevent flies getting to it and blowing it. It was moistened occasionally with water to prevent it from drying up. When both were similarly covered, blow-flies kept continuously buzzing round and settling upon the gauze covering of the former, while none or very few came to the latter.

Other substances were also tried, with like results, though their attractiveness without maggots varied with the different substances, and with the same substance at different stages.

Since this was seen to be the case, pepsin was tried to see if it acted in the same way. It was found, however, that both fish and meat after they had been acted upon by pepsin in the presence of hydrochloric acid, attracted fewer flies than did the controls of meat or fish alone. The flies used were chiefly *Lucilia*.

Peptone was also tried, both moistened with water and mixed with bread; sometimes maggots were also added *. A variety

* The maggots did not thrive in these mixtures. They appeared unhappy and restless, often escaping out of the dishes.

of flies came to these peptone baits, but not in very large numbers, *i. e.*, a certain number of *Calliphora*, *Lucilia*, and *Fannia*, a few *Musca* and *Sarcophaga*, as well as many *Piophila*.

The blow-flies were always more attracted by meaty substances, although quite a number of them have been caught when mixtures of peptone were the only baits exposed.

Some of the different organs, as well as ordinary meat (muscle), and also dead birds, fish, etc., were used as baits. Of these, liver, brain, and fish were the most attractive, remaining so for a considerable time. Blow-flies very soon came to feed on these when exposed in sunny places, so that they became blown very quickly. When the digestive action of the maggots had had time to act upon the baits, they were extremely attractive, but gave off a most offensive smell. Since liver, brain, and fish were the most attractive of the meaty substances, they were tested against each other, in order to find out their relative attractiveness. First, the attractiveness of each for blow-flies was tested separately, when the mouths of two of the jars were closed by being covered by glass plates. Later, two at a time were left open, and finally all the three were left open together. Liver was then found to be by far the most attractive, although when fish and brain were exposed alone, they each caught a considerable number of flies.

Details and results are given below in Table I.

TABLE I.

Comparison of the Attractiveness for Blow-flies of liver, brain, and fish.

Liver (horse) + maggots (7 days old).	Fish (mackerel or whiting) + maggots (7 days old).	Brain (horse) + maggots (7 days old).
Open.	*Closed.*	*Closed.*
Very many flies caught.		
Closed.	*Open.*	*Closed.*
	Very many flies caught.	
Closed.	*Closed.*	*Open.*
		Very many flies caught.
Open.	*Open.*	*Closed.*
All the flies went here.	No flies came.	
Closed.	*Open.*	*Open.*
	Few flies came.	Many flies came.
Open.	*Closed.*	*Open.*
No Record.		
Open.	*Open.*	*Open.*
Very many flies came; far more than to either of the others.	Hardly any flies came.	A certain number of flies came.

As a further test of the attractiveness of liver, another piece (three days old) was placed in the slaughter-house yard near a large trap baited with a horse's head. It was certainly attractive, catching about 400 flies * in 24 hours, showing that liver still attracted even amongst all the counter attractions of the slaughter-house yard.

The following lists (F–I) give the summary of the results from the experiments with the different meaty substances.

F. *Substances found to be most and continuously attractive to Blow-flies* (Lucilia *and* Calliphora) †.

Liver + maggots.
Meat + „
Brain + „
Fish + „
Hard-boiled eggs + maggots.

G. *Substances slightly attractive on first day, and also subsequently.*

Fish (under wire-gauze trap).
Boiled meat.
„ „ + maggots.
Marrow in bone.
„ „ + maggots.
Dead birds (mostly sparrows).

H. *Substances not attractive till second day, and then moderately so.*

Meat + pepsin + HCl.
Fish + „ + „
Meat + Methyl Indol.

I. *Substances unattractive to Blow-flies.*

Blood.
Bacterized blood, *i.e.* blood prepared with putrefying bacteria.
Fresh hard-boiled egg.
Fat.
Freshwater mussel (*Anodon*).
Hard-boiled egg + Methyl Indol.
Fresh meat + Skatol.
Unblown meat (covered by wire-gauze trap).
Alcoholic extract of putrid meat + bread.
„ „ „ „ + bread + maggots.
„ „ „ egg + bread.
„ „ „ „ + „ + maggots.

* The actual count was 138 *Lucilia*, +49 *Calliphora*, +51 *Fannia*, + 97 *Grœnlandica*, +57 flies too damaged to recognize, +4 which escaped. Total 396.

† In these and all subsequent experiments the blow-flies used were *Lucilia* and *Calliphora*. *P. grœnlandica* were only used in the first experiments, when it was still early in the season for the other species.

III. *Experiments with various fruit and vegetable baits.* (*June–July.*)

These experiments were carried out in the same way and under the same conditions as those on meaty substances. Shredded meat was sometimes mixed with the baits, but even then they were never so attractive to blow-flies as meat alone. None of the substances, even after they had been kept for a considerable time, were found to be at all attractive to blow-flies, though in some instances a few flies came to them. These substances are marked with an asterisk (*) in the following list:—

Hay infusion.
Boiled cabbage.
Raw cabbage (cut up and moistened with water).
Boiled lettuce.
Raw „ (cut up and moistened with water).
Boiled grass.
Grass + water.
Boiled potatoes.
Raw „ (cut up and moistened with water).
Water in which cabbage, lettuce, and grass had been boiled.
Dates.
„ + water.
Banana.
* „ + maggots.
* „ + „ + meat.
* „ + meat.
„ + vinegar.
Squashed strawberries.
*Strawberries + meat.
* „ + „ + maggots.
„ + yeast + „
„ + maggots.
*Strawberry jam + meat.
* „ „ + „ + maggots.
*Stinkhorn fungus (*Phallus*).

Further, certain household substances were used, such as bread and cheese, milk, vinegar, etc., as well as mixtures of casein, bread, and water, both with and without maggots.

The results are given below:—

Baits.	*Results.*
Treacle	Unattractive.
„ + water	„
Brown sugar	„
„ „ + water	„
„ „ + „ + meat	„
„ „ + „ + yeast	„
Oxo + bread + water	„
„ + „ + „ + maggots	„
Bread + vinegar	„
„ + „ + jam	„
„ + „ + „ + maggots	„

Baits.	*Results.*
Bread + cheese + milk	Few Blow-flies, *Fannia*, and many *Piophila* caught.
„ + „ + „ + maggots	None caught till 2nd day, when flies (as above) caught.
„ + „ + water	12 Blow-flies + 12 *Fannia* + 1 House-fly came on 1st day. Kept for 15 days and few caught each day.
„ + „ + „ + maggots	
Milk, fresh	Unattractive.
„ sour	Few *Calliphora* caught.
Casein + water	*Fannia* + some Blow-flies and many *Piophila* caught.
„ + „ + maggots	
„ + „ + bread	On 4th and 15th days many Blow-flies caught (when no meat baits exposed). On most days a few Blow-flies as well as *Fannia* and *Piophila* caught + a few *Musca*.
„ + „ + „ + maggots	*Musca* + *Lucilia* and *Calliphora* + few *Sarcophaga* + many *Piophila* caught—both at the Zoo and when put by manure-heap at Brentford.
„ + „ + „	

Summary :—

It was found that for Blow-flies—

(1) The most attractive baits were :—

(*a*) Liver + maggots.
(*b*) Brain + „
(*c*) Fish + „
(*d*) Hard-boiled egg + maggots.

Of these, liver + maggots gave the best results.

(2) Meaty substances of all kinds were more attractive than either chemical or vegetable substances. More flies came to them than ever came to the vegetables or chemicals, even when these two latter were the only available baits for the flies; although certain substances, notably mixtures of casein and peptone with water and bread, showed possibilities of being good baits when they were the only attractions present. They then caught a number of different species (i. e. *Musca*, *Calliphora* and *Lucilia*, *Sarcophaga*, *Fannia*, and *Piophila*).

(3) The digestive action of blow-fly maggots on meat, etc. added to their attractiveness.

(4) The best way to attract and catch blow-flies was to put the baits in sunny places.

(5) The great drawback, however, to the general employment of any of the meaty substances, or of the mixtures of casein, water, and bread, or of peptone, water, and bread, is the most objectionable smell which is given off when they have been kept for any length of time; yet it is only after keeping them thus that their most attractive stage is reached. It would, however, be possible to use them out of doors, in the garden, or elsewhere away from the house, where the smell would not matter so much.

Baits for House-flies.

Methods and account of Experiments.

These experiments on house-fly baits were carried out at Acton Lodge, Brentford, during the latter half of July and in August.

The first experiments were made out of doors (*a*) near a manure-heap, from which flies were emerging, (*b*) in or near a forge, where a number of house-flies were congregating in the warmth.

In neither of these cases, however, were the conditions very favourable, chiefly on account of the wet and windy weather. Later, half a bushel of house-fly pupæ was collected from a neighbouring manure-heap, and placed in a greenhouse, where most of the subsequent experiments were made. This greenhouse was empty, excepting for some tomato-plants on the upper shelves (the flies did not like them, and would not settle or sit on the leaves). Ventilation was secured by nailing muslin over two of the windows. Very soon the greenhouse was swarming with flies, which had emerged from the pupæ. These flies were used in the experiments.

The supply of flies was kept up by breeding them in artificial media, consisting of mixtures of bread, casein *, water, and banana, and banana-skins, surrounded by a dry layer of cut grass, leaves, etc., in which the maggots could pupate; all of which were placed in large saucers on the floor, under the shelves. It was thus possible to keep up a continuous supply of flies.

In experimenting, the mixtures to be used as baits were placed in glass jars with wire-gauze funnels (the same as those used in the blow-fly experiments). The date and time of starting the experiment were noted, and usually a morning (9–11 A.M.) and evening (4.30–6.30 P.M.) count of flies taken, when the jars were emptied of flies and the dead (if any) removed.

The average duration of the experiments was 8–9 days.

The substances tested were very various. Mixtures of casein and peptone, which had seemed from the blow-fly experiments to be promising baits, were tried, as well as all sorts of other substances, *e. g.* sugars, jams, fruits, etc., both alone and mixed with casein and peptone. After some time it was found that the casein mixtures were more attractive than most of the other substances used. Hence experiments were made to try to discover when, and under what conditions, and mixed with which substances these casein baits were most attractive. It was found that the best results were obtained with approximately equal parts of casein and brown sugar; or casein and banana; or

* The idea of using mixtures of casein, banana, etc. for breeding purposes was suggested by the fact that eggs were laid on some of the casein and banana baits in the jars, and that the larvæ lived in them. It was found very successful for breeding and keeping up a continuous supply of house-flies, both in this greenhouse and in the "fly-room" at the Imperial College. Flies were bred in large numbers from August 1915, and are still increasing (June 1916).

casein, banana, and brown sugar; or casein, banana, and golden syrup; or casein and bread — all of which were mixed with sufficient water to make into a paste. These mixtures, moreover, generally required a day or two in which to ripen before reaching their most attractive stage, which then lasted for a considerable time.

They were tested, amongst others, against the well-known recipe of beer and sugar, which was found to be immediately attractive, though it did not remain so for any length of time, only about two or three days. It was subsequently seen that the addition of beer, or preferably stout, to the casein, sugar, and banana mixtures, or to casein alone, made them immediately attractive, and that, when the effect of the beer or stout had gone off, the casein mixtures were themselves attractive and remained so for many days.

Several of these casein mixtures were also tested in the kitchen, but only a certain number of the flies were caught. This was probably due to the various counter-attractions present, though on one occasion * twenty house-flies were caught between 5 P.M. and 10 A.M. the next morning. This number was well over half the flies in the kitchen, though on other occasions fewer were generally caught. Yet these baits, even in the greenhouse, where as many as 600 have been caught in 6–7 hours, never by any means caught all the flies, but only a proportion of them. Other methods are likely to be found more effective in ridding kitchens of flies than the use of baited traps, *e. g.* spraying or fly-papers.

Other casein baits were also placed in different parts of the garden, as well as by the dust-bin, when various flies were caught, including *Musca*, *Calliphora*, *Lucilia*, *Fannia*, a few *Sarcophaga* and many *Borborus*; though more blow-flies were always caught with meat baits.

A summary of the results obtained from the experiments on House-fly Baits is given below (J–O). The substances are classified according to their attractiveness.

(N.B.—The days only are given on which the largest number of flies were caught. In most cases fewer flies were caught on the other days as well.)

(J) *Substances found to be the most attractive to House-flies.*

Baits.	*Days on which most flies were caught (i. e. approximately 90–100 or more flies at each of the counts).*
Casein + golden syrup + bread + water	9–10
„ + brown sugar + water	3–8
„ + bread + water	3–6
„ + brown sugar + dried blood + water	3–6
„ + „ „ + „ „ + „ + maggots .	1–4

* The bait consisted of casein + brown sugar + beer (3 days old).

Casein + bread + water	5–12
„ + brown sugar + water	3–6
„ + banana + water	1–6
„ + „ + brown sugar + water	3–8
„ + golden syrup + brown sugar + water	1–4
„ + white sugar + water	1–2
„ + „ „ + „ + Alc.	5–8
Beer + brown sugar	1–4
Casein + „ „ + stout	1–2
„ + „ „ + „	3–4 & 7–8
„ + stout	1–4 & 1–12
Brown sugar + stout	1–6
Casein + golden syrup + stout	3–8
Pudding (made of egg, gelatine, sugar and milk)	1–6
Horlick's Malted Milk + water *	1–6
„ „ „ + „ + banana	3–4
Casein + banana + Malt Extract + water	5–6
„ + brown sugar + water	5–10
„ + „ „ + „ + bread	5–10
„ + golden syrup + bread + water	1–2 & 7–8
Cornflower + milk + sugar *	3–4
Bird's Custard Powder + white sugar + milk *	1–4
Boiled milk + white sugar + starch	1–2
Casein + brown sugar + water (boiled together)	1–2
Dutch cheese + brown sugar + water	1–2
Casein + water (boiled together)	3–6

(K) *Substances attractive, though in a less degree than those given in* (J).

Baits.	*Days on which most attractive (when approximately 60–80 flies caught at each count).*
Casein + brown sugar + water	3–4
„ + Alcohol + water	11–12
„ + Malt Extract	3–6
„ + bread + banana + water	3–4
„ + water (boiled together)	1–2
Toasted cheese	1–2
Casein + brown sugar + beer	1–2

(L) *Substances to which Flies still came, though never more than approximately* 30–50 *were caught at each count.*

Baits.	*Days on which the above number of flies were caught.*
Banana + maggots	5–6
Casein + „ + bread + water	11–12
Brown sugar + Alcohol + water	1–2
Casein + water	5–12
„ + brown sugar + beer	1–2
Horlick's Malted Milk + brown sugar + water	3–4
Bird's Custard Powder + boiled water	5–8

* Most of the flies died which fed on the three baits marked with an asterisk (*).

(M) *Substances to which Flies still came, though never more than about* 20–30 *were caught at each count.*

Baits.	*Days on which the above number of flies were caught.*
Casein + brown sugar + water	3–4 & 7–8
„ + white „ + „ + Alcohol	1–2
„ + golden syrup + „ + „	7–8
Boiled milk	1–4
Toasted casein + water	1–12
Casein + bread + „	4–6

(N) *Substances to which never more than about* 10–20 *came.*

Baits.	*Days on which the above number of flies were caught at each count.*
Golden syrup + alcohol	1–2
Brown sugar + „	1–2
Casein + brown sugar + water	1–10
„ + water	1–4
Boiled milk + white sugar	1–2
„ „ + stout	1–4
„ cheese + water	1–2
Dutch „	1–2

(O) *Substances unattractive to House-flies, and to which fewer than* 10 *flies at most came.*

Baits.	*Days exposed.*
Green treacle + bread	1–6
Golden syrup + „	1–6
Casein + green treacle + bread + water	1–6
Peptone + „ „ + „ + „	1–6
„ + golden syrup + „ + „	1–6
Casein + vinegar	1–6
„ + „ + yeast	1–2
„ + brown sugar + yeast + water	1–2
„ + vinegar + yeast + water	1–2
Peptone + toffee	1–4
„ + brown sugar + water	1–4
„ + „ „ + „ + yeast	1–4
Casein + toffee (cooked together)	1–4
„ + „ + maggots	1–4
Toffee + maggots	1–4
Casein + bread + water (at manure-heap)	1–4
„ + yeast + vinegar + maggots	1–4
„ + brown sugar + water	1–8
„ + golden syrup + „	1–12
Alcohol + water	1–4
Casein + brown sugar + water	1–6
Jam	1–4
Casein + Kepler's Malt Extract + water	1–8
Milk	1–8
„ + brown sugar	1–8
„ + Kepler's Malt Extract	1–8

Brown sugar + Kepler's Malt Extract	1–8
Malt Extract	1–8
Casein + water (boiled together)	1–8
„ + banana + water	1–4
„ + bread + „	1–6
Bird's Custard Powder + boiled milk	1–4
„ „ „ + „ water + brown sugar	1–8
Brown sugar + starch (boiled together)	1–12
Starch + boiled water	1–4
Casein + brown sugar + dried blood + water	1–8
„ + „ „ + beer + water	1–4
Condensed milk	1–6
„ „ + jam	1–6
Bread + Dutch cheese + water	1–6
"Ridge's Food" + water	1–5
„ „ + brown sugar + bread + water	1–5

The main conclusions arrived at from these experiments on house-fly baits were :—

(1) That the most satisfactory baits consisted of—

(*a*) Mixtures of casein, sugar, or some other sweet stuff and water, with or without banana, in approximately equal proportions, to which stout or beer can be added, in which case they became immediately attractive, otherwise one or two days elapsed before the most attractive stage was reached * ;

(*b*) Horlick's Malted Milk mixed with water ;

(*c*) Banana, especially when over-ripe ;

(*d*) Custard puddings ;

(*e*) Cornflour, milk, and sugar ;

(*f*) Bird's Custard Powder, milk, and sugar, etc. (*vide* list J).

(2) There are advantages in using the casein mixtures rather than the other attractive baits in

(*a*) the comparative cheapness of casein (1*s*. 4*d*. per lb.) and

(*b*) the little trouble the baits take to prepare, the ingredients simply requiring to be mixed into a paste with a little water ;

(*c*) The length of time they remain attractive (7–10 days as compared with the 2–3 days of beer and sugar) ;

(*d*) The absence of any disagreeable smell when the casein is mixed with sugar, golden syrup, banana, etc.†

* In November and December, however, the house-flies at the Imperial College came in swarms to feed on the casein mixtures as soon as they were placed on the bench. They even came to bread only. Was this because of the difference in the hunger-states of the flies at these different times, or were the casein mixtures more attractive when simply put out on the bench without being covered by a trap ?

† Sugar, beer, alcohol, etc. had another advantage, as they appeared to preserve the baits from going mouldy, which often happened when casein was used alone, though this did not necessarily prevent them from being attractive. The great advantage was, however, that they kept them from giving off the most offensive smell which was the case when casein and water, and casein, water, and bread were used.

Yet in these experiments, at no time were all the flies caught, but only a proportion of them. This was, however, only to be expected, judging from the catholicity of their tastes; yet they have their likes and dislikes.

It was found that the attractiveness of most substances varied at different times. The weather appeared to influence them—as a rule fewer flies were caught on dull days than on sunny ones. Possibly, also, flies of different ages and sexes have different likes and dislikes, all of which would affect the numbers caught and the attractiveness of the baits.

III. Poisons for Flies.

These experiments were made with the object of trying to discover a substance which would be poisonous to flies—especially house-flies—and harmless to man. It should not be distasteful to the flies, otherwise they will not come to feed, and unless cheap and easily obtained will not be suitable for general use.

The following methods of testing the different substances were employed:—

(i.) To expose an attractive bait, to which the poison had been added, in a place where the flies were free to come and feed, or not, as they liked.

(ii.) To test the poison on flies which were confined, and must either eat it or starve.

(i.) *Account of Experiments on Poison-baits when Free Flies were used.*

These experiments were carried out in the greenhouse. The flies used were chiefly house-flies, though a certain number of blow-flies from traps were released from time to time.

The substances used were generally placed in large saucers, in sunny places on the floor. They were then watched, to see whether after feeding, (*a*) the flies fell over immediately, apparently dead, or (*b*) crawled for a distance and then fell over on their backs, or (*c*) whether they flew away apparently unharmed. When the two former occurred, as many of the "corpses" as could be found were collected and kept till the next day, to see if they would recover.

It was thus possible to obtain some idea of the effect of the different substances on the flies, and also to see whether their addition made any difference to the attractiveness of the baits. They were generally added to mixtures of casein, banana, sugar, and water. Controls for comparison were arranged for each series of experiments.

A list of the various substances used, together with a summary of results, is given on p. 497.

Substances tested.	*Results.*
Borax ..... Boric acid	Did not poison house-flies or blow-flies. Made no difference in attractiveness of bait for house-flies, but were repellent to blow-flies.
Picric acid (bait yellow)	Made no difference in attractiveness for house-flies or blow-flies: both fed greedily upon it, and were apparently unharmed!
Amyl alcohol.....	Strongly repellent to both house-flies and blow-flies.
Amyl acetate.....	Repellent to house-flies; but after the smell had gone off the baits were again attractive, and eggs were laid and larvæ lived in them. Flies were killed when it was poured into trap containing them.
Antimony oxide ...	Did not kill house-flies, and made no difference in attractiveness for them.
Acetaldehyde.....	Disliked by house-flies and blow-flies.
Westoran	Flies were killed when it was poured into trap containing them. Next day no apparent difference seen in attractiveness of baits.

Certain experiments were also made to test the poison-effect of paraformaldehyde and formaldehyde.

Some typical results are given in the table on p. 498.

It was not possible to arrive at any very definite conclusions from the above experiments with formalin, as the results were so varied. Sometimes the flies died after feeding on the mixtures, while at other times they were apparently unharmed. Some days they came in large numbers to feed, and on other days few or none came. Generally speaking, more seemed to come on fine than on dull days. One thing, however, seems clear, which is, that if formalin is used in practice for ridding rooms or buildings of flies, the "corpses" should be swept up and burnt as soon as possible, so as to prevent any possibility of recovery.

It was, however, felt that further and more accurate experiments should be made to test the poison-effect of formalin, etc., on house-flies, where known quantities of formalin were added to known amounts of bait. An account of these experiments is given below.

(ii.) *Account of Experiments on Poison-baits when House-flies were confined in cylinders.*

In order to secure more definite results than was possible in the greenhouse, the following experiments were made at the Imperial College of Science, in one of the laboratories, having an ordinary roof with no skylights. Thither the breeding-materials, maggots and pupæ from the greenhouse, were transferred. Very soon enormous numbers of flies had emerged, which were used in the experiments. The supply was kept up by breeding them in the same way as before.

The substances to be tested, placed on pieces of glass, were fed

Baits.	*Results.*		
	With Paraformaldehyde added.	With Formalin added.	*Controls.*
(A.) (*a*) Various casein, sugar, and banana mixtures placed in saucers in the greenhouse.	Made no difference to the attractiveness of bait to house-flies or blow-flies. Harmless to both.	*Used strong.* Repellent to house-flies and blow-flies. *Used weak.* Repellent to blow-flies, but house-flies seemed not to detect it until sufficient had been absorbed to kill them, or render them helpless. In no case were all of these latter found to be really dead, a certain number recovering after a time. In one case, out of the 600 picked up as dead, 21 % had recovered the next morning. The proportion of recoveries was often larger than this.	Attractive to house-flies, many of which fed — as well as some blow-flies.
(*b*) Meat	.....	Repellent to blow-flies.	Attractive to blow-flies: very many came and fed.
(*c*) Custard Pudding.	.....	F. added while pudding hot. Very attractive to house-flies: very many fed, and soon died in and around the saucer.	Very attractive to house-flies.
(B.) Baits consisting of casein, sugar, and water were fed to house-flies enclosed in muslin cages in greenhouse.	(1) Flies still alive after three days, and then released. (2) Another lot kept for five days and then released as flies still alive.	.....	.....
(C.) Balloon trap set over casein, sugar, and water mixtures in greenhouse.	.....	Many house-flies came to feed, which were afterwards caught in balloon traps, where they were kept for two days and then released as flies still alive.	
(D.) Various casein, sugar, and water baits placed in jars with funnels in greenhouse.	Sometimes unattractive for many days: other times attractive on first day. Occasionally one or two flies died.	Generally attractive for one to three days. Many flies died.	Attractive: many flies caught. None died.

to house-flies enclosed in glass cylinders with muslin tops (height 8 inches, diameter 9 inches), which stood on the bench. When flies were needed for the cylinders, either they were taken from those caught in balloon traps set over the breeding-saucers, or pupæ were placed inside the cylinders to hatch out, etc.

In each experiment the following points were noted :—

(*a*) the date and time of starting ;

(*b*) the source of the flies ;

(*c*) whether they came to feed at once ;

(*d*) the number of flies (if any) lying apparently dead on the bench, inside the cylinders, (1) after the first hour, (2) each morning and evening ; and

(*e*) whether any were feeding at those times.

The experiments usually lasted four days, as any substance which failed to kill by that time was considered useless. At the end of the experiment a count was made of the total number of males and females which had died, and also which had lived to the end of the experiment, when they were etherized before being counted.

The baits used were mixtures of casein, sugar, banana, and water ; that most generally employed consisting of the following proportions :—

25 c.c. casein + 25 c.c. brown sugar + 25 c.c. banana.

(*a*) If the poison was a liquid, it was simply mixed in with the casein etc.

(*b*) If it was soluble, it was dissolved in 25 c.c. of water and added to the casein etc.

(*c*) If it was insoluble, it was mixed with 25 c.c. of water and added to the casein etc.

Controls with clean baits—*i. e.*, 25 c.c. casein + 25 c.c. sugar + 25 c.c. banana + 25 c.c. water—were set up for each series of experiments : usually one control for all the experiments made on the same day.

Details of these experiments, with percentage of deaths etc., are given in Table II.

The results obtained from the experiments on poisons, when tested on house-flies enclosed in cylinders, were not very decisive (Table II.). No substance was found which killed a really large proportion of the flies. Tables III. and IV. respectively give the poison-mixtures having the largest percentage of deaths on the first day, and on the second day in cases when none had died before that. Substances which killed later than this, or where the death-rate was less than 10 per cent. on the first or second day, were not considered of much practical value. The highest percentage of deaths on the first day was only 31,

(*Text continued on p. 514 at end of Tables.*)

Table II.

Experiments on Poison-Baits for House-flies, with Flies confined in Cylinders.

Reference Number and Date of Starting.	Percentage of Formalin or other poison + Mixture (in Roman numerals)*.	Total number of Flies used, and Time of Starting Experiment.	Percentage of Flies which were lying on the bench, apparently dead, at different times, *i. e.* after first hour and in morning and evening.								Percentage of House-flies (♂ + ♀) which died during experiment.		Percentage of House-flies (♂ + ♀) which lived to end of experiment.		Remarks.
			Day 1.		*Day* 2.		*Day* 3.		*Day* 4.						
			1st hour.	Rest of day.	A.M.	P.M.	A.M.	P.M.	A.M.	P.M.	♂	♀	♂	♀	
(5) 27.8.15	2 c.c. 40 p. c. F + ii.	87 (p) × 4.0	...	...	39 [5*th day*, 99 ; 6*th d*	66	... *ay*, 100.]	92	97	99	100	100	0	0	
(6) 23.8.15	5 c.c. 32 p. c. F + i.	75 (p) ÷10.45	3, *f*	8	*f* [5*th day*, 95.]	51	64 (dry)	70	85	...	100	100	0	0	
(7) 28.8.15	5 c.c. 29 p. c. F + i.	73 (p) ÷10.45	8, *s* (12.45)	21 [5*th*	44, *s* *day*, 99 ; 6*th da*	...	81 (dry) *y*, 99.]	88	84	...	108	97	0	3	
(8) 28.8.15	5 c.c. 28 p. c. F + i.	84 (*i. e.* 66 (p) +18 (eth.)) ×12.45	4	11 [5*th day*, 63 ;	21 6*th day*, 71 ;	...	(dry) 7*th day*, 84.]	23	45	...	100	100	0	0	
(9) 23.8.15	5 c.c. 27·6 p. c. F + i.	62 (*i. e.* 34 (p) +28 (eth.)) 12.45	...	3 [5*th*	26 *day*, —; 6*th da*	...	47 (dry) *y*, 100.]	65	71	...	100	100	0	0	
(10) 28.8.15	5 c.c. 40 p. c. F + i.	87 (*i. e.* 51 (p) +36 (eth.)) × 2.0	8 (2.45)	14	23 [5*th day*, 100.]	...	40 (dry)	55	79	...	100	100	0	0	
(11) 28.8.15	5 c.c. Picric acid + i. (dissolved in 90 p. c. Alc.) (bright yellow).	87 (*i. e.* 77 (p) +10 (eth.)) ÷ 3.0	0	0	0 [5*th day*, 98.]	4, *f*	24 (dry)	40, *f*	69, *f*	...	100	95	0	5	

* For full details of baits, see Key to Table II. on p. 517.

(12) 28.8.15	5 c.c. Picric acid + i. (dissolved in water) (yellow).	42 (p)	× 3.0	0	0 [5th day, —; 6th day, 24.]	0	0, *f*	0 (dry)	4	21	...	67	29	33	71	
(13) 28.8.15	2 c.c. 40 p.c. F + i.	84 (*i.e.* 64 (p) + 20 (eth.))	× 3.0	0	... [5th day, —; 6th day, 100.]	12	...	51 (dry)	65	75	...	100	100	0	0	
(14) 28.8.15	2 c.c. 40 p.c. F + i. (part on glass and part in dish).	73 (p)	× 4.0	4 (4.20)	5 (4.45)	... (1.30)	33 [5th day, 100.]	48 (dry)	53	86	...	100	100	0	0	
A(15)[4] 29.8.15	iii.	87 (p)	÷ 1.45	6, *f* (2.0)	9	17, *f* (dry)	33 [5th day, 95.]	48	...	69	...	93	57	7	43	
A(16)[4] 29.8.15	iv.	63 (p)	2.0	16, *f* (3.20)	...	21	33 [5th day, 83.]	54 (dry)	...	68	...	95	74	5	26	
A(17)[4] 29.8.15	28 p.c. F + v.	86 (*i.e.* 65 (p) + 21 (eth.))	÷ 3.0	17 (4.45)	17	29	35	37	...	58	74	90	64	10	36	
A(18)[4] 29.8.15	36·7 p.c. F + v.	82 (p)	× 3.30	11 (4.15)	(4.45) 15	20	29 [5th day, 71.]	41, *f*	...	66, *f* (dry)	...	69	71	31	29	
A(19)[4] 29.8.15	32 p.c. F + v.	67 (p)	3.45	0	0	6, *f*	15 [5th day, 51.]	22	...	40, *f* (dry)	...	64	43	36	57	
A(20)[4] 29.8.15	29 p.c. F + v.	70 (p)	× 4.15	24 (4.35)	(4.45) 27	40	41, *f*	55	...	71	81	91	73	9	27	
Control A(21)[4] 29.8.15	W + v.	78 (*i.e.* 38 (p) + 40 (eth.))	× 4.30	0, *m* (4.40)	0, *f*	0, *f*	1, *f*	1, *f*	1, *f*	1, *f*	1, *f*	[1]		[99]		No record of the sexes.
B(22)[1] 30.8.15	40 p.c. F + vi.	87 (p)	11.15	7 (11.40)	14	24	...	33	40, *f*	...	46, *f*	60	31	40	69	

TABLE II. (*continued*).

Reference Number and Date of Starting.	Percentage of Formalin or other poison + Mixture (in Roman numerals).	Total number of Flies used, and Time of Starting Experiment.		Percentage of Flies which were lying on the bench, apparently dead, at different times, *i. e.* after first hour and in morning and evening.								Percentage of House-flies (♂ + ♀) which died during experiment.		Percentage of House-flies (♂ + ♀) which lived to end of experiment.		Remarks.
				Day 1.		*Day* 2.		*Day* 3.		*Day* 4.						
				1st hour.	Rest of day.	A.M.	P.M.	A.M.	P.M.	A.M.	P.M.	♂	♀	♂	♀	
B(23)[1] 30.8.15	36·7 p. c. F + vi.	63 (p)	÷11.40	6, *f* (11.50)	22	27	...	46, *f*	71		79	94	66	6	34	
B(24)[1] 30.8.15	32 p. c. F + vi.	74 (p)	11.45	16 (12.5)	(2.10) 27	43	...	64	73	84	...	94	86	6	14	
B(25)[1] 30.8.15	30·5 p. c. F + vi.	61 (p)	* 11.55	15 (12.15)	(5.45) 31	33	...	56	69	...	84	93	73	7	27	
B(26)[1] 30.8.15	29 p. c. F + vi.	71 (p)	12.15	4	14	18, *f*	...	35, *f*	46	58	...	74	51	26	49	
B(27)[1] 30.8.15	27·5 p. c. F + vi.	61 (p)	12.20	15, *f*	16	26	...	48	54	77	...	79	64	21	36	
Control B(28)[1] 30.8.15	W + vi.	90 (p)	×12.30	0	0, *f* [*5th day*, 0; *6th day*, 0.]	0, *f*	...	0, *s*	0, *s*	0, *s*	...	0	0	100	100	
B(29)[1] 30.8.15	W + vi. + (40 p. c. F in another dish, covered with muslin).	82 (p)	×12.55	*m*, 0	0, *f*	0	...	1, *f*	2, *f*	6, *f*	...	[3]	[2]	...	...	Actual numbers of dead given; percentage impossible, as sex of survivors not recorded.
B(30)[1] 30.8.15	24 p. c. F + vi.	86 (p)	3.30	10 (3.35), *f*	22	19, *f*	...	37, *f*	72, *f*	98	...	100	95	0	5	
B(31)[1] 30.8.15	36 p. c. F + vi.	74 (p)	× 4·0	11 (4.10), *f*	19	35, *f*	...	54, *f*	66, *f*	95	...	97	93	3	7	

B(32)[1] 30.8.15	25·5 p.c. F + vi.	86 (p)	× 4.0	12 (4.25)	12	23, *f* ...	48, *f*	62, *f*	91	...	100	82	0	18
B(33)[1] 30.8.15	30 p.c. F + vi.	84 (p)	× 4.10	7, *m* (4.25)	...	32 ...	61	71, *f*	94	...	76	91	24	9
(34)[1] 30.8 15	vii.	75 (p)	× 5.15	0, *m*	...	1, *f* ...	40, *f*	68, *f*	92	...	95	88	5	12
(35)[1] 31.8.15	1 c.c. Chloral hydrate + viii.	78 (p)	×11.0	0	...	5 ... [*5th day*, 9, *f*; *6th day*, 9.]	8	...	9, *f*	...	23	9	77	91
(36)[1] 31.8.15	5 c.c. Chloral hydrate + viii.	19 (p)	÷11.45	0	...	0 ... [*5th day*, 16; *6th day*, 21.]	5	...	11	11	35·5	9	72·5	91
(37)[2] 1.9.15	1 c.c. Pepper mixed with viii. + a little dusted on top of bait.	(About) 40 (p)	÷10.45	0	0	0 0 [*5th day*, 0.]	0	0, *f*	0	0, *f*	0	0	100	100
(38)[2] 1.9.15	1 c.c. Zn. Sulph. Carbl. + viii. (dissolved in little water).	31 (p)	11.15	0	0	0 0 [*5th day*, 0.]	0	0	0	0	0	0	100	100
(39)[2] 1.9.15	1 c.c. Calomel + viii. (half mixed in and half dusted over).	47 (p)		...	2	2 ... [*5th day*, 13.]	6	4, *f*	6	...	4	25	96	75
Control (40)[2] 1.9.15	viii.	53 (p)	12.5	10, *f*	0, *f*	0, *f* ... [*5th day*, 2.]	2, *f*	2, *f*	2, *f*	2, *f*	0	2	100	98
(41)[2] 1.9.15	2 c.c. Quillaia Bark + viii. (in 10 c.c. Alc.).	31 (fl)	3.20	0, *f* (at edges)	3	6, *f* ... [*5th day*, 13.]	6, *f*	6, *f*	6, *f*	6	17	11	83	89
(42)[2] 1.9.15	2 c.c. Acetal + viii.	56 (fl)	÷ 3.30	0	0	2, *f* ... [*5th day*, 2.]	2, *f*	2, *f*	2, *s*	2	0	2	100	98

TABLE II. (*continued*).

Reference Number and Date of Starting.	Percentage of Formalin or other poison + Mixture (in Roman numerals).	Total number of Flies used, and Time of Starting Experiment.		Percentage of Flies which were lying on the bench, apparently dead, at different times, *i. e.* after first hour and in morning and evening.								Percentage of House-flies (♂ + ♀) which died during experiment.		Percentage of House-flies (♂ + ♀) which lived to end of experiment.		Remarks.
				Day 1.		*Day* 2.		*Day* 3.		*Day* 4.						
				1st hour.	Rest of day.	A.M.	P.M.	A.M.	P.M.	A.M.	P.M.	♂	♀	♂	♀	
(43)[2] 1.9.15	2 c.c. Ethyl formate + viii.	77 ((p) + (eth.))	×3.50	0, *f*	0	1, *s* [*5th day*, 1.]	...	1, *f*	...	1, *f*	1, *f*	1	0	99	100	The flies are survivors from A(21).
C(45)[3] 1.9.15	1 p. c. F + vi.	46 (fl)	10.45	0, *f*	0	11, *f*	17, *f*	33, *s*	44, *s*	44, *f*	50	67	32	33	68	
Control C(46)[3] 2.9.15	W + vi.	x (fl)	11.0	0, *f*	0, *f* [*5th day*, 0, *f*;	0, *f* *6th day*, 0, *f*;	0, *f*	0, *f* *7th day*, 0;	0, *f* *8th*	0, *f* *day*, 0.]	0, *f*	0	0	100	100	
C(47)[3] 2.9.15	5 p. c. F + vi.	26 (fl)	11.30	12 (11.45)	15 (2.45)	19	38	46, *f*	65	73, *f*	81	100	74	0	26	
C(48)[3] 2.9.15	10 p. c. F + vi.	54 (fl)	12.45	0	(2.45) 2, *f*	15, *f*	46, *f*	61, *f*	69, *f*	78, *f*	85	100	78	0	22	
C(49)[3] 2.9.15	1 p. c. $CuSO_4$ + vi. (pale green).	66 (fl)	3.30	2 (3.40)	...	3, *f*	3	3, *f*	3, *f*	3, *f*	3	5	0	95	100	The 66 flies used in this experiment were those from B(29).
(50)[3] 3.9.15	1 p. c. Kl. + vi.	47 (fl)	× 3.40	0, *f*	0, *f* [*5th*	0, *f* *day*, 4;	0, *f* *6th da*	0. *f* *y*, 4.]	0, *f*	2, *s*	4, *f*	5	4	95	96	
(51)[3] 3.9.15	2 c.c. Carvone + viii.	91 (fl)	÷10.0	0 (2.30) 4	(5.15) 10	18, *f*	36, *f*	55, *f*	59, *f*	71	...	92	44	8	56	
(52)[3] 3.9.15	1 c.c. 1 p. c. Nic. + ix.	40 (fl)	10.30	0, *f*	0	0, *f*	0, *f*	0	0	0	0	0	0	100	100	

(53)[3] 3.9.15	1 drop Pyrid. + ix.	90 (p)	×11.0	0, *s*	0, *s*	0, *f* (+5 drops Pyrid.)	0, *f*	0 (+6 drops Pyrid.)	0, *f*	0	0, *f*	0	0	100	100	[5*th day*, 0 (+1 c.c. Pyrid. +new bait) 0.]
(54)[3] 3.9.15	2 c.c. Trimeth. + ix.	52 (fl)	×12.30	4 (2.0)	4, *f*	4, *f*	6, *f*	4, *f*	4, *f*	6	...	7	8	93	92	
(55)[3] 3.9.15	5 c.c. Abs. Alc. + ix.	x (fl)	× 2.45	0, *m*	0, *f*	0	0	[1]	[1]	[1]	...	[1]	0	?	100	1 ♂ died—impossible to give percentage as number of flies unknown.
(56)[3] 3.9.15	2 c.c. Amyl Alc. + ix.	37 (fl)	÷ 5.0	0	0	0	0	0, *f*	0	0	0	0	0	100	100	
(57)[5]	1 grm. Pot. Salic. + viii.	33 (fl)	×11.45	15 (12.15)	27, *f*	27, *f*	36	55, *f*	67, *f*	79, *f*	82	84	78	16	22	These are the actual numbers of flies which died, and which survived, as 10 others escaped by accident at end of experiment, and hence percentage impossible in last 2 columns.
(58)[5] 3.9.15	1 grm. Tannic Acid + viii. (light brown).	39 (fl)	×11.45	5, *s* (12.25)	23, *f*	23, *f*	23, *f*	23, *f*	23, *f*	28, *f* (dry)	28	[8]	[0]	[13]	[8]	
(59)[5] 4.9.15	x. (mst.).	x (fl)	×12.25	0, *f*	0, *f*	0, *f*	[1], *f*	[1], *f*	[4], *f*	[4]	[6]	[3]	[2]	...	...	These are the actual deaths, percentage impossible as total number of flies unknown.
(60)[5] 4.9.15	1 grm. Salic. Acid + xi.	61 (fl)	×12.25	0, *m*	2	10, *f*	16, *f*	51, *f*	62, *f*	74	72	86	69	14	31	
(61)[5] 4.9.15	5 grm. Caff. + xi.	34 (fl)	12.50	0	0, *f*	3, *f*	9, *f*	18	29, *f*	32, *f*	62, *f*	100	41	0	59	
(62)[5] 4.9.15	1 grm. Pot. salic. + viii. (brownish green).	27 (fl)	× 3.40	0, *f*	0	7, *f*	22	44, *f*	59	70	82, *f*	100	80	0	20	
Control (63)[5] 4.9.15	viii.	35 (fl)	4.0	0, *s*	0, *s* [5*th day*, 0; 9*th day*,	0, *f* 6*th day*, 0;	0, *f* 7*th* 0; 10*th day*,	0 *day*, 0; 63; 11*th day*,	0, *s* 8*th day*,	0, *s* 0, *m*; 97.]	0, *s*	100	94	0	6	

TABLE II. (*continued*).

Reference Number and Date of Starting.	Percentage of Formalin or other poison + Mixture (in Roman numerals).	Total number of Flies used, and Time of Starting Experiment.	Percentage of Flies which were lying on the bench, apparently dead, at different times, *i. e.* after first hour and in morning and evening.								Percentage of House-flies (♂ + ♀) which died during experiment.		Percentage of House-flies (♂ + ♀) which lived to end of experiment.		Remarks.
			Day 1.		*Day* 2.		*Day* 3.		*Day* 4.		♂	♀	♂	♀	
			1st hour.	Rest of day.	A.M.	P.M.	A.M.	P.M.	A.M.	P.M.					
(64)[6] 4.9.15	1 p. c. Picric acid + vi.	36 (fl) × 3.15	...	(5.15) 3	3 [*5th day*, 8.]	3, *f*	3, *f*	3, *f*	6, *f*	8, *f*	17	6	83	94	
Control (65)[6] 5.9.15	viii.	28 (p) × 3.30	0	0 [*5th day*, 7, *f*;	4	7 *8th day*, 7.]	4, *f*	7, *f*	7, *f*	7	0	[1]	100	...	1 ♀ died, percentage impossible since sex of survivors unknown.
(66)[6] 5.9.15	1 p. c. Cu Acetate + vi.	39 (fl) × 3.40	0	0	0 [*5th day*,	0 3.]	0	3, *f*	3, *f*	...	0	3	100	97	
(67)[5] 6.9.15	2 c.c. Citric acid + viii.	60 (fl) × 2.30	0	0, *f*	0, *f*	2, *f*	2, *f*	2	2	2	2	0	97	100	
(68)[5] 6.9.15	1 c.c. Chromic acid + ix. (bright yellow).	49 (fl) × 2.40	0, *s*	0, *f*	8, *f*	31, *f*	49, *f* (dark brown).	84	94	94	100	92	0	8	
(69)[5] 6.9.15	2 c.c. Lead chromate + xi. (bright yellow).	29 (fl) ÷ 3.0	0	0	0, *s*	0, *f*	0, *s*	0	0	0	0	0	100	100	
(70)[5] 6.9.15	2 c.c. Red Lead + xi. (bright red).	39 (fl) × 3.30	0, *s*	0, *f*	0, *s*	0, *f*	0, *f*	0	0, *s*	0, *f*	0	0	100	100	
(71)[5] 6.9.15	2 c.c. Lead acetate + viii.	47 (fl) × 3.40	0, *s*	0, *f*	0, *f*	0, *f*	0, *f*	0	0	0	0	0	100	100	
(72)[5] 6.9.15	2 c.c. Lead nitrate + viii. (mst.).	83 (fl + p) × 3.55	0, *s*	0, *f*	1, *s*	...	13, *s*	23, *m*	42, *f*	...	56	35	44	65	

(73)[5] 6.9.15	1 c.c. Amyl acetate + ix.	33 (fl)	5.15	0	0	0, *f*	0	0, *s*	0, *f*	3	3	12·5	0	87·5	100	
(75)[5] 9.9.15	2 c.c. Lead Carb. + xi.	39 (fl)	×11.0	0, *f*	0	0 [*5th day*, 0.]	0, *f*	0	0	0 (dry)	0	0	0	100	100	The 39 flies used in this experiment were those from (70).
(76)[8] 10.9.15	2 c.c. Meth. salic. + ix.	16 (fl)	÷11.45	0	0 [*5th day*, 0 ;	0 *6th day*,	0 0.]	0	0	0	...	0	0	100	100	
Control (80)[8] 10.9 15	W + vi.	29 (fl)	×10.30	0, *s*	0, *f*	0, *f*	...	0, *f*	0, *f*	0, *f*	..	0	0	100	100	
(81)[8] 10.9.15	5 c.c. $KClO_3$ + viii.	x (p)	× 2.30	0	0, *f*	0, *f* [*5th day*, 0, *m*.]	0, *f*	0, *f*	...	0, *f*	0	0	0	100	100	
(82)[8] 10.9.15	2 c.c. (?) $BaSO_4$ + xi.	28 (p) (Flies from (65)).		0, *s*	0 [*5th d*	0, *f* *ay*, 4, dry ;	0 *6th*	0, *f* *day*, 7.]	...	0, *f*	0	0	9	100	91	
(83)[8] 10.9.15	1 p. c. NaOH + vi.	18 (fl + p)	× 3.20	0, *f*	0 [*5th day*,	0 0, dry ;	0 *6th day*,	0 0 (mld.)]	0	0	0	0	0	100	100	
(85)[8] 10.9.15	5 grms. NH_4NO_3 + viii.	19 (fl)	4.20	0	... [*5th*	53 *day*, 89 ;	53 *6th d*	58 *ay*, 100.]	...	74	74	100	100	0	0	
(86)[9] 13.9.15	5 c.c. Oil of Turp. + ix.	9 (fl)	÷11.50	0	...	0	0	0	...	....	...	0	0	100	100	
Control (89)[9] 15.9.15	W + vi.	x (p*)	11.30	0, *f*	0, *f* [*5th day*, 0 ;	... *6th day*	0 [1] ;	0 *8th day*	0 [3].]	0	0	0	[2]	[1]	...	...	These are actual numbers of deaths. Percentage impossible as total number of flies unknown.
(92)[9] 15.9.15	xii. (Pyrethrum).	48 (p*)	× 1.15	0, *m*	...	0, *f* [*5th day*, 0.]	...	0, *f*	0	0	0	0	0	100	100	

TABLE II. (*continued*).

Reference Number and Date of Starting.	Percentage of Formalin or other poison + Mixture (in Roman numerals).	Total number of Flies used, and Time of Starting Experiment.	Percentage of Flies which were lying on the bench, apparently dead, at different times, *i. e.* after first hour and in morning and evening.								Percentage of House-flies (♂ + ♀) which died during experiment.		Percentage of House-flies (♂ + ♀) which lived to end of experiment.		Remarks.
			Day 1.		*Day* 2.		*Day* 3.		*Day* 4.						
			1st hour.	Rest of day.	A.M.	P.M.	A.M.	P.M.	A.M.	P.M.	♂	♀	♂	♀	
(93)[9] 16.9.15	2 c.c. Household Ammonia + ix.	13 (fl*) ×11.15	0, *s*	...	0 [*5th day*, 0.]	...	0	...	0, *f*	0	0	0	100	100	
(94)[9] 16.9.15	1 grm. Oxalic acid + viii.	29 (fl*) ×12.20	0, *s*	...	24	...	24	24	24	28	43	17	57	83	
(95)[9] 16.9.15	2 grms. KBr + viii.	35 (fl*) 2.25	...	...	17, *s*	...	57, *f*	20, *f*	66, *f*	...	78	55	22	45	
(98)[9] 16.9.15	2 grms. Kl. + viii.	x + 15 (p) × 3.30	0, *s*	0, *f*	0 [*5th day* [15].]	...	[1] *f*	[2] *f*	[8] *f*	...	[8]	[7]	...	...	These are the actual deaths, percentage impossible as total number of flies unknown.
(99)[10] 20.9.15	2 grms. Oxalic acid + viii.	x + 4 (fl) ÷10.20	0	0	0	...	0	[4]	...	...	[1]	[3]	...	...	Ditto.
(100)[10] 20.9.15	To be starved.	x (fl. fed one day on clean bait). 10.20	0	0	0	...	0	0	...	...	0	0	100	100	
(101)[10]	5 grms. KBr + viii.	x (fl) ×10.45	0	0, *f*	0, *f*	...	3	...	...	...	0	[3]	100	...	Ditto.
(102)[10] 20.9.15	10 grms. NH_4NO_3 + viii.	x (fl) 11.30	0	0	[4], *f*	...	[10]	...	...	...	[3]	[7]	...	...	Ditto.
(103)[10] 20.9.15	5 grms. Na_2CO_3 + viii.	x (fl) ×11.45	0	0	0	...	0	...	...	...	0	0	100	100	

(104)[10] 20.9.15	5 grms. White Lead + xi.	x (fl)	×12.10	*f*	0	0 ... [5*th day*, 50.]	0	...	...	...	0	0	100	100	5 flies found to have died from *Empusa muscæ*; these are included in percentage for columns 1–5, but not calculated in percentage of dead and survivors.
(105)[10] 20.9.15	1 c.c. Carvone + $\frac{\text{ix.}}{2}$ (kept for 3 days before fed to flies).	14 (fl)		...	0	0, *f* ... [5*th day*, 50.]	0, *f*	7	14	...	0	33·3	100	66·7	
(106)[10] 20.9.15	5 c.c. Chromic acid + viii. (kept for 3 days before fed to flies).	8 (fl)		...	...	12.5, *f* ... [5*th day*, 87·5.]	37·5	50	75	...	[1]	[3]	...	...	These are actual deaths, percentage impossible as total number of flies unknown.
(107)[10] 20.9.15	1 grm. Camphor + xi.	x (fl)	×12.45	0, *s*	...	0 ...	0	...	...	...	0	0	100	100	
(108)[10] 20.9.15	1 c.c. Amyl nitrite + ix.	x (fl)	÷ 1.50	0	...	0 ...	0	...	...	...	0	0	100	100	
Control (109)[10] 20.9.15	W + vi.	x (fl)	4.45	0	...	0 ...	0	...	...	...	0	0	100	100	
(110)[10] 22.9.15	10 grms. NH_4NO_3 + viii. (mst.).	x (fl)	×11.10	0, *f*	(4.10) [2]	... ...	...	...	...	...	[1]	[1]	...	...	These are actual deaths, percentage impossible as total number of flies unknown.
(112)[11] 23.9.15	5 grms. Kl. + viii.	17 (fl)	× 1.10	0	0	0 ... [5*th day*, 94.]	24, *f*	35	47	...	100	90	0	10	4 flies found to have died from *Empusa muscæ*; they are included in percentage in columns 3–7, but not in last two.
(113)[11] 23.9.15	5 grms. KBr + viii.	16 (fl)	1.15	...	...	19, *f* ... [5*th day*, 100.]	69, *f*	87·5	87·5	...	100	100	0	0	
(114)[11] 23.9.15	10 grms. NH_4NO_3 + viii.	8 (fl)	2.30	0	0	0 ...	37·5	37·5	87·5	...	100	100	0	0	
Control (115)[11] 24.9.15	viii.	10 (fl)		0	0	0 0 [5*th day*, 30.]	0	0	1	...	100	66·5	0	33·5	

TABLE II. (*continued*).

Reference Number and Date of Starting.	Percentage of Formalin or other poison + Mixture (in Roman numerals).	Total number of Flies used, and Time of Starting Experiment.		Percentage of Flies which were lying on the bench, apparently dead, at different times, *i. e.* after first hour and in morning and evening.								Percentage of House-flies (♂ + ♀) which died during experiment.		Percentage of House-flies (♂ + ♀) which lived to end of experiment.		Remarks.
				Day 1.		*Day* 2.		*Day* 3.		*Day* 4.						
				1st hour.	Rest of day.	A.M.	P.M.	A.M.	P.M.	A.M.	P.M.	♂	♀	♂	♀	
(116)[11] 24.9.15	2 grms. Sb-oxychl. + xi.	19 (fl)	×11.5	...	...	13 [*5th day*, 84.]	47, *f*	...	...	84	95	80	75	20	25	1 fly died from *Empusa muscæ*. It is included in percentage of columns 3–7 only.
(117)[11] 24.9.15	5 c.c. Adren. HCl. + ix.	15 (fl)	×11.15	2 (2.15)	...	13, *f*	7, *f*	27	27	27	...	33·3	20	66·7	80	Ditto.
(118)[11] 25.9.15	To be starved.	16 (fl)	11.20	...	...	6 [*5th day*, 94.]	(3.30) 19	44	...	69	94	[5]	[7]	...	...	These are the actual deaths, percentage impossible as sex of survivors unknown.
(119)[11] 24.9.15	3 drops Ethyl SCN + ix.	17 (fl)	11.25	41 (2.15) +12 (h)	...	82 [*5th day*, 65.]	71	65	...	53	65	100	86	0	14	It was seen in other experiments that it was the Ethyl sulphocyanide vapour which "killed" the flies. They fell over apparently dead almost as soon as the bait was fed to them, and before any had eaten at all. If it was removed after a few minutes, they all recovered again.
(120)[11] 24.9.15	5 drops Allyl Sulphocyanate + ix.	x (fl)	2.15	0	0	0 [*5th day* (0).]	0	[0]	...	[0]	...	0	0	100	100	1 ♀ died. Percentage impossible as total number of flies unknown.
(121)[11] 25.9.15	xiii.	x (fl)	12.10	0	0	0	0	0	0	[1]	...	0	...	100	...	One fly died of *Empusa muscæ*; it is not counted in percentage.
(122)[11] 25.9.15	xiv.	x fl	2.10	0	0	0	...	[0]	[0]	[0]	...	0	0	100	100	

(126)[11] 27.9.15	5 grms. Sb-oxychl. +xi.	8 (fl) (*i.e.* 6+2 stb.)	11.55	...	0	25	37·5	37·5	37·5	50	...	100	20	0	80	
(127)	2 c.c. Mustard Oil. +ix.	5 (fl)	×11.55	0, *f*	0	0	0	25	25	25	...	0	33·3	100	66·7	Ditto.
(128) 28.9.15	Br.+xv.	7 (fl)	2.45	0	0	0	0	0, *f*	0	0	0	0	0	100	100	
(129) 28.9.15	xvi.	4 (fl)	2.15	0	...	0	0	...	...	0	0	0	0	100	100	
(130) 28.9.15	Br.+xvii.	5 (fl)	÷ 3.50	24 (4.15)	(5.30) 60	0	60 (h)	0, *s*	...	33·7, *f*	...	0	0	100	100	
Control (133)[12] 2.10.15	vii.	x (p′)	11.45	0 [*5th day*, 0, *f*;	0 *6th day* [1];	... *7th day*	... [1];	0 *8th day*, —	0 ; *9th day*	0 [3].]	...	[3]	...	...	...	These are the actual deaths, percentage impossible as total number of flies unknown.
(136)[12]	To be starved.	x (p)		0	0	0 [*5th day*, All.]	0	[4]	[6+1 (em)]	[20]	[27]	100	100	0	0	Ditto.
(137)[12] 4.10.15	1 c.c. Acetaldehyde +ix.	x (p)	×11.15	0, *f*	...	0	0	0	0	...	...	0	0	100	100	
(138)[12] 4.10.15	2 c.c. Dimethan. +ix.	x (p)	÷11.30	0	0	0	0	0	0	...	...	0	0	100	100	
(139)[12] 4.10.15	2 c.c. Butyric acid +ix. (mst.).	x (fl)	11.45	0	0	0	0	0	0	...	...	0	0	100	100	
(141)[12] 4.10.15	5 c.c. Iodine+ix. (greenish yellow).	x (fl)	3.35	0	0	0	0	0	0	...	...	0	0	100	100	
(142) 8.12.15	To be starved.	39 (fl*)	10.0	...	·3	...	82	95	...	100	...	100	100	0	0	
20.12.15	To be starved.*	4 (fl)	4.30	0 [*5th day*, 50; *6th* *9th day*, 50;	0 *day*, 50;	0 *7th day*, 50; 10*th day*, 50;	0	0 11*th day*, 100.]	0 *8th day*, 50;	0	50	[0]		[100]		Unfortunately sex not noted.

* These four house-flies were caught in Refreshment Room on Rugby Station. They were put in a glass tube and kept in a room with a temperature of 45°–50° F.

Table III.

Poisons which killed largest percentage of Flies on first day.

Order.	Ref. No. in Table II.	Baits. (For full details, see Key to Table II., p. 517.)	Percentage of pure poison in whole mixture.	Percentage of Flies which died on first day.
1.	25	25 c.c. 30 p. c. Formalin + vi.	7·5	31
2.	24	25 c.c. 32 p. c. „ + vi.	8	27
	20	25 c.c. 29 p. c. „ + vi.	7·5	27
	57	1 grm. Potass. salic. + viii.	1	27
3.	58	1 grm. Tannic acid + viii.	1	23
4.	23	25 c.c. 36 p. c. Formalin + vi.	9	22
	30	25 c.c. 24 p. c. „ + vi.	6	22
5.	7	5 c.c. 29 p. c. „ + i.	5	21
6.	31	25 c.c. 36 p. c. „ + vi.	9	19
7.	17	25 c.c. 28 p. c. „ + v.	7	17
8.	27	25 c.c. 27·5 p. c. „ + vi.	6·9	16
9.	47	5 c.c. 5 p. c. „ + vi.	1·25	15
	18	25 c.c. 36 p. c. „ + v.	9	15
10.	10	5 c.c. 40 p. c. „ + i.	7	14
	22	25 c.c. 40 p. c. „ + vi.	10	14
	26	25 c.c. 29 p. c. „ + vi.	7·25	14
11.	32	25 c.c. 25·5 p. c. „ + vi.	6·3	12
12.	51	2 c.c. Carvone + viii.	2	10

Table IV.

Poisons which killed largest percentage of Flies on second day, when none had died on first day.

Order.	Ref. No. in Table II.	Baits. (For full details, see Key to Table II., p. 517.)	Percentage of pure poison in whole mixture.	Percentage of Flies which died on second day.
1.	5	2 c.c. 40 p. c. Formalin + i. *a.*	2	66*
2.	85	5 grm. NH_4NO_3 + viii.	5	53
3.	116	2 grm. Sb. oxychl. + xi.	2	47*
4.	84	25 c.c. 40 p. c. Formalin + vi.	10	45
5.	126	5 grm. Sb. oxychl. + xi.	5	37·5
6.	68	1 c.c. Chromic acid + viii.	1	31
7.	94	1 grm. Oxalic acid + viii.	1	24
8.	62	1 grm. Potass. salic. + viii.	1	22
9.	118	Starved Flies.	—	18
10.	95	2 grm. Potass. bromide + viii.	2	17
	45	25 c.c. 1 p. c. Formalin + vi.	0·25	17
11.	19	25 c.c. 32 p. c. „ + v.	8	15
12.	13	2 c.c. 24 p. c. „ + i.	2	12

* No record was made on the first day in these two experiments. It is therefore not known whether any flies died then or not.

Table V.

Details of Experiments when Poison-baits were fed to House-flies, and Clean-baits to Survivors; showing percentage of Diaths, etc. amongst Original Flies and Survivors, as well as in Starved Flies and Controls.

Poison-baits. (For full details see Key to Table II.)	Total number of Flies used in Expt.	Total length of time Flies were given Poison-bait.	Percentage of Deaths from Poison-bait.		Total number of Flies which survived.	Total length of time survivors were given clean bait.	Percentage of deaths amongst survivors with clean bait.		Average death-rate per diem.	
			(a) *On 1st day.*	(b) *During whole time.*			(a) *On 1st day.*	(b) *During whole time.*	(a) *Amongst origl. Flies.*	(b) *Amongst survivors.*
Carvone + ix.	45	5 days	4 p.c. (after 4–6 hours)	33 p.c.	30	5 days	0 p.c. (1st deaths on 2nd day when 7 p.c. died.)	14 p.c.	7 p.c.	3 p.c.
Chromic Acid + viii.	23	3 „	0 p.c. („ 2–3 „)	43 p.c.	13	5 „	0 p.c. (1st deaths on 3rd day when 46 p.c. died.)	61 p.c.	14 p.c.	12 p.c.
10 p.c. Formalin + vi.	14	1 „	14 p.c. („ 7 „)	28 p.c.	10	3 „	10 p.c.	10 p.c.	28 p.c.	3 p.c.
5 p.c. „ + vi.	25	1 „	8 p.c. („ 5–7 „)	40 p.c.	15	3 „	0 p.c.	0 p.c.	40 p.c.	0 p.c.
1 p.c. „ + vi.	29	2 „	0 p.c. („ 6–8 „)	4 p.c.	28	1·5 „	0 p.c.	4 p.c.	2 p.c.	3 p.c.
40 p.c. „ + vi.	38	1 „	7 p.c. („ 15 mins.)	44 p.c.	21	3 „	0 p.c.	0 p.c.	44 p.c.	0 p.c.
10 p.c. „ + vi.	47 (*m*)	1 „	14 p.c. („ 1½ hours)	76 p.c.	11	2 „	20 p.c.	40 p.c.	76 p.c.	20 p.c.
30 p.c. „ + vi.	39	1 „	5 p.c. („ 1 „)	48 p.c.	20	2·5 „	5 p.c.	10 p.c.	48 p.c.	4 p.c.
20 p.c. „ + vi.	52	1 „	8 p.c. („ 2½ „)	52 p.c.	26	2 „	16 p.c.	20 p.c.	52 p.c.	10 p.c.
Control	29 flies in 4 days		.....	0 p.c.						
„	28 „ 6 „		.....	7 p.c.						
„	35 „ 9 „		.....	0 p.c.						
„	*x* „ 5 „		.....	0 p.c.						
Starved flies	39 flies in 3 days		2 p.c. (after 6–8 hours)	100 p.c.						
„ „	27 + *x* „ 5 „		0 p.c. („ 24 „)	100 p.c.						
„ „	16 „ 5 „		6 p.c. („ 24 „)	94 p.c.						

and this was with a 30 % formalin bait (*i. e.*, 25 c.c. of 30 % formalin in 75 c.c. of casein mixture), making 7·5 % of pure formalin (Table III.). Amongst substances which did not kill until the second day, excluding No. 5 * of Table IV., ammonium nitrate (*i. e.*, 5 % pure NH_4NO_3) gave the highest percentage (53 %). Next came 40 % formalin (45 %), and then antimony oxychloride (37·5 %). For the percentages with the other substances, see Table IV.

Other experiments were also made to see what was the effect of first feeding a poison-bait to the flies in the cylinders, and then a clean bait to the survivors. Details of these experiments, giving percentages of deaths, etc., will be found in Table V.

The results seem to show that the flies died after a longer or shorter time from the effects of feeding upon the poisons, and not from starvation due to not feeding on the baits because they were distasteful, for in most cases flies were seen to feed. Also, in the experiments on starving flies, it was seen that these flies could live longer before succumbing than did the flies which had been given poison-baits; for in these the percentage of deaths during the first hours was very high—much higher, in fact, than amongst the starved flies for a corresponding length of time. Again, the percentage of deaths in those experiments where the poison-bait was left for more than one day was much lower than was found amongst the starved flies for a period of three days or more. It appears that when flies died from the effects of feeding upon those baits in which the poison was more concentrated they quickly absorbed sufficient to kill them, but that this took a longer time with weaker poisons, unless the bait was very attractive and they fed so greedily upon it as to imbibe a sufficient amount of the poison to kill them in a shorter time. This is apparently what happened with a 10 % formalin bait, which was very attractive, and to which very many of the flies came to feed at once and continued feeding for some time. On the other hand, if they fed less continuously a longer time elapsed before death took place. Probably the large percentage of deaths amongst the survivors with clean baits, as compared with the death-rate in the controls, was due to the poison previously absorbed in the first case.

Starved Flies.—From experiments on starving flies (Tables II. and V.) it seems that they show more power of resistance late in the year than in the autumn. For in the experiments made on starving flies in November and December they remained alive without food for 7–10 days, or even longer; while in those made in September and October all the flies were dead by the sixth day. The greater resistance shown by the winter flies than by the autumn ones is what would be expected if they have to pass the winter as imagines.

* This is not counted, although it had the highest death-rate, because no record was taken on the first day, and it is very probable that some of the flies died on that day.

General Summary.

The general conclusions resulting from these experiments on baits and poisons for flies, show that:—

(1) For Blow-flies, meaty substances of all kinds make the best baits, and of these the most attractive was blown liver, several days old. It was found that the digestive action of the maggots increased the attractiveness of the baits.

(2) The most satisfactory House-fly baits consisted of mixtures of casein, banana, and some sweet substance (*i. e.* treacle, sugar, etc.) to which sufficient water, beer, or stout was added to make a paste.

(3) Apparently Formalin remains the best poison for House-flies for indoor use, in spite of its somewhat uncertain action. The best results were obtained when 2·5 % to 7·5 % pure Formalin was used.

Note on *Empusa muscæ*.

It is perhaps worth noting that the house-flies in the "fly-room" became badly infected with the fungal disease *Empusa muscæ* in September and October, and died in great numbers, although they still continued to breed. It is interesting to note that however they became infected, the disease followed its usual course and subsided in November and December, when "wild" flies have normally disappeared.

Carbolic acid was evaporated two or three times a day at first, and occasionally up to the end of December.

Note on the Proportion of the Sexes in House-flies (*Musca domestica*).

(1) The proportion of male and female House-flies was found to be nearly equal in the various counts made on emerging flies. The results are given below:—

	♂.	♀.
(*a*) Pupæ taken from manure-heap which hatched out Aug. 7, 1915.	51	66
(*b*) Flies emerged from pupæ bred in greenhouse, Aug. 27, 1915 ...	52	35
(*c*) Ditto, Aug. 26–30, 1915	51	102
(*d*) Ditto, Aug. 27–28, 1915	57	39
(*e*) Ditto, 11 A.M. to 2 P.M., Aug. 28, 1915	60	53
(*f*) Ditto, at 2.45 P.M., August 28, 1915	121	67
(*g*) Ditto, at 3.30 P.M., Aug. 28, 1915	80	111
(*h*) Flies emerged from pupæ from breeding-saucers Feb. 11, 1916...	31	27
Total	503	500

(2) Counts were also made of Flies caught in balloons and

other traps. In all cases but one, a much larger number of females was caught. This is probably to be accounted for by the fact that the substances used as baits served also for breeding-materials. The following results were obtained :—

	♂.	♀.
A. In the greenhouse.		
(*a*) Flies caught in jar with wire-gauze funnel, baited with an eight days' old mixture of casein, water, and bread, 3–5 hours after Amyl acetate had been added, July 25, 1915	19	227
(*b*) Flies caught in jar with wire gauze-funnel, baited with two days' old stout and sugar, Aug. 1, 1915	25	85
(*c*) Flies caught on piece of banana, placed on shelf in sun. (Very many flies came to feed, and many eggs were laid.) As many as possible of the flies were caught	16	32
B. In the "fly-room."		
(*a*) Flies caught in balloon trap, set for ½–1 hour over casein, brown sugar, banana, and water bait, Nov. 29, 1915	26	118
(*b*) Ditto, Dec. 10, 1915	90	83
(*c*) Ditto, Dec. 11, 1915	24	36
(*d*) Ditto, Dec. 13, 1915	43	54
(*f*) Ditto, for ¼ hour, Dec. 15, 1915	86	108
(*g*) Ditto, for 1½ hours, Feb. 9, 1916	13	22
(*h*) Ditto, for 1 hour, Feb. 9, 1916	31	43
(*i*) Ditto, for 24 hours, Feb. 10, 1916	28	52
Total	401	860

(3) Counts were also made of the flies which died naturally, which had been picked up in the "fly-room" in August and September. The proportion of males and females was approximately equal. The numbers are given below :—

	♂.	♀.
(*a*) Dead flies picked up in fly-room on Aug. 28, 1915	122	99
(*b*) Ditto, Aug. 20 to Sept. 2, 1915	132	143
Total	254	242

(4) Again, in the experiments where various poison-baits were fed to house-flies enclosed in cylinders (Table II.) only in 14 out of 69 cases was the percentage of deaths among the females higher than that of the males.

List of Abbreviations.

Alc.	Alcohol (90 % unless otherwise stated).
Abs.Alc.	Absolute Alcohol.
Adren.HCl.	Adrenalin hydrochloride, ·01 % solution.
Caff.	Caffeine.
Dimethan.	Dimethylaniline.
Ethyl.SC.N.	Ethyl sulphocyanide.
F.	Formalin.
Meth.salic.	Methyl salicylate.
Nic.	Nicotine.
Potass.salic.	Potassium salicylate.
Pyrid.	Pyridine.

Salic. acid	Salicylic acid.
Sb.oxych.	Antimony oxychloride.
Turp.	Turpentine.
Zn.Sulp.Carbl. ...	Zinc sulphocarbolate.
dry	bait dry or getting dry.
eth.	house-flies used in experiments after they had recovered from being etherized.
f	few flies feeding on bait (*i. e.* about 3–6 flies).
m	many flies feeding on bait (*i. e.* most flies in cylinder).
mst.....	bait moist, often with liquid coming out at edges.
(*h*)	flies helpless but alive.
s	some flies feeding on bait (*i. e.* about 8–10 flies).
×	flies came at once to feed on bait.
÷	flies did not come at once to feed.
*	flies came at once to bait, but did not stay.
(p)	pupæ (*i. e.* flies which had emerged from pupæ placed in cylinder).
(p*)	Flies emerged from pupæ (p), and which had been given no food for several hours before experimental bait fed to them.
(p^1)	Flies newly emerged from pupæ (p).

The index numbers to reference number of experiments in Table II. indicate that the same control was used for all the experiments with the same index, *e. g.* $(41)^2$, $(42)^2$, etc.

Key to Mixtures used as Baits in Experiments in Table II.

Mixture i.=Approx. 100 c.c. casein.
+100 c.c. brown sugar.
+one banana.
+water to mix into a paste
} Mixed together at one time, and of which approx. 25 c.c. were used for each experiment, and to which Formalin was added.

Mixture ii. (5 only)=Same as Mixture i. but of which 35 c.c. was used for the experiment, and to which 2 c.c. of 40% Formalin was added.

Mixture iii. (15 only)=15 c.c. casein.
+15 c.c. brown sugar.
+40% Formalin.

Mixture iv. (16 only)=15 c.c. casein.
+15 c.c. brown sugar.
+10 c.c. water.
+5 c.c. 40% Formalin.

Mixture v.=25 c.c. casein.
+25 c.c. brown sugar.
+25 c.c. Formalin (percentage specified in each case).
} Mixed separately for each experiment.

Mixture vi.=25 c.c. casein.
+25 c.c. brown sugar.
+25 c.c. banana.
+25 c.c. liquid (percentage of Formalin, or other liquid, specified in each case).
} Mixed separately for each experiment.

Mixture vii.=25 c.c. casein.
+25 c.c. brown sugar.
+25 c.c. 24 % Formalin in milk (*i. e.* milk (not water) added to make up to 24 % F.).

Mixture viii.=25 c.c. casein.
+25 c.c. brown sugar.
+25 c.c. banana.
+25 c.c. water.
} Mixed separately for each experiment. The various substances used were dissolved in 25 c.c. water, before it was added to mixtures. In Controls water only was used.

Mixture ix.=25 c.c. casein
+25 c.c. brown sugar.
+25 c.c. banana.
+25 c.c. water.
} Mixed separately for each experiment. Before the water was added to the mixture, the liquid (specified in each case) was added to the water.

Mixture x. (59 only) = 25 c.c. casein. + 25 c.c. brown sugar. + 25 c.c. banana. + 25 c.c. water. } 1 grm. benzoic acid dissolved in 4 c.c. of 90 % of alcohol was added to the 25 c.c. water (when benzoic acid precipitated). The whole was mixed into the mixture.

Mixture xi. = 25 c.c. casein.
+ 25 c.c. brown sugar.
+ 25 c.c. banana.
+ 25 c.c. water, in which the various insoluble substances were mixed.

Mixture xii. (92 only) = 25 c.c. casein.
+ 25 c.c. sugar.
+ 25 c.c. banana.
+ 5 c.c. pyrethrum powder extract (alc.).

Mixture xiii. (121 only) = 12·5 c.c. casein.
+ 12·5 c.c. brown sugar.
+ 12·5 c.c. banana.
+ 12·5 c.c. of ($\frac{1}{20}$ exol. mark iii. + 1 % mustard oil + 0·25 ethyl sulphocyanide).

Mixture xiv. (122 only) = 12·5 c.c. casein.
+ 12·5 c.c. brown sugar.
+ 12·5 c.c. banana.
+ 12·5 c.c. 1 : 20 ethyl thiocyanide + cinnamic + exol mark iii.

Mixture xv. (128 only) = Brown bread soaked in (1 c.c. exol mark iii. + 1 grm. sugar + 18 c.c. water).

Mixture xvi. (129 only) = Paper sprayed with (1 c.c. exol mark iii. + 1 grm. sugar + 18 c.c. water) and allowed to dry before fed to flies in cylinder.

Mixture xvii. (130 only) = Brown bread soaked in 3 drops ethyl sulphocyanide + 25 c.c. water.

Iodine (141 only) = 5 c.c. of (1 grm. iodine dissolved in 5 c.c. of 90 % alcohol).

(NB.—All solutions aqueous unless otherwise stated.)